

**Claims 1, 7-9 and 15 and claims 2 and 10-12 are separately rejected under 35 U.S.C.**

**§ 102 for lack of novelty as evidenced by Choi et al., U.S. Patent No. 6,168,991 (hereinafter Choi)**

On pages four and five of the Office Action, the Examiner asserted that Choi identically describes the claimed invention as recited in claims 1-2, 7-12 and 15. These rejections are respectfully traversed.

In the Amendment filed October 18, 2002, Applicants amended each of independent claims 1 and 2 to recite that the tantalum nitride films of a storage electrode and a cell plate electrode each have a work function greater than 4.95 eV. Applicants then argued that Choi fails to teach or suggest this feature. In an Office Action dated December 12, 2002, the Examiner responded to these arguments by referring to column 5, lines 26-30 of Liang et al., to support an assertion that tantalum nitride inherently has a work function greater than 4.95 eV. In an Amendment filed March 12, 2003, Applicants responded by arguing that the doctrine of inherency cannot be applied to this particular limitation because the Examiner cannot establish that the work function of tantalum nitride must be greater than 4.95 eV. Applicants also referred to two references (Gotoh et al. and Rogers) that disclosed that the work function of tantalum nitride can be below 4.95 eV.

In the present Office Action, the Examiner responded to Applicants' arguments with the following statement:

regarding Applicant's traverse of examiner's statement that the work function of tantalum nitride inherently is greater than 4.95 eV, the documents included in Applicant's Amendment D do not support Applicant's thesis for said traverse. In particular, the text by Goto [sic] et al is unacceptable at least because of its unpublished nature, while the publication by B. R. Rogers, Thin Solid Films, Volume 408, pp. 87-96 (2002) reinforces the examiner's opinion, because for

the pure tantalum nitride surface a value of 5.15 eV for its work function is cited (cf. Table 2) while the sputtered surface has a different work function because it is no longer pure tantalum nitride, but instead also contains aluminum (Al) (cf. section 4: "Discussion", in particular pp. 93-94, and Table 2), and hence is aluminum tantalum nitride instead of tantalum nitride. Furthermore, in addition to the already cited patent by Liang the examiner also herewith cites Barnak et al (US 2002/0008257 A 1). Both Rogers and Barnak et al do not qualify under 35 U.S.C. 102 or 103 as prior art in view of their recent dates of publication and the early date of Applicant's filing. However, neither is a citation as prior art the objective, because given a material structure the work function is well defined.

The Examiner's analysis of both Gotoh et al. (hereinafter Gotoh) and Rogers is misplaced on several accounts. As to Gotoh, notwithstanding the Examiner's assertion that Gotoh has not been published, whether or not the article by Gotoh has been published in a journal has no bearing on the accuracy of the data disclosed therein. Therefore, the Examiner should consider Gotoh as another brick in the foundation of references that disclose that the work function of tantalum nitride can be below 4.95 eV.

The Examiner's assertion that Rogers reinforces the Examiner's belief that tantalum nitride inherently has a work function greater than 4.95 eV is misplaced. The following is a direct citation from Rogers:

The work function of the sputter cleaned TaN film measured 4.20 eV, surprisingly similar to that of pure Ta metal film. Although this particular TaN<sub>x</sub> film was approximate 1:1 composition, other sputtered TaN<sub>x</sub> films with lower N content were found to have similar work functions. Furthermore, sputtering the stoichiometric TaN film with Ar<sup>+</sup> rather than Xe<sup>+</sup>, or with varying Xe<sup>+</sup> energies up to 4 keV did not produce measured work functions differing from 4.20 eV by more than 0.2 eV.

Rogers, therefore, specifically discloses that tantalum nitride has a work function that can be below 4.95 eV. The Examiner's assertion that it is aluminum tantalum nitride that has the lower work function is without factual basis. The "sputtered surface" indicated in Table 2 refers to a surface that has been cleaned (see second full paragraph in the second column of page 94) but prior to aluminum deposition.

Applicants also note that the Examiner's discussion regarding the dates of publication of the references is immaterial. These references are not being used as prior art within the meaning of 35 U.S.C. §§ 102, 103. Instead, these references are being used to indicate that the work function of tantalum nitride film, which is an inherent property, has greater variability than that asserted by the Examiner. Put another way, hypothetically, would the Examiner ignore the teachings of a periodic chart merely because the periodic chart was published after the filing date of an application?

Notwithstanding the Examiner improperly ignoring the teachings of Goth and Rogers, Applicants submit herewith in Appendix A three additional references that teach that tantalum nitride can have a work function below 4.95 eV. In an article entitled Characterization of resistivity and work function of sputtered-TaN film for gate electrode applications, Kang et al. state that "there exists a significant variance in reported work functions of TaN varying from 4.13 eV (similar to that of  $n^+$  poly-Si) to 5.05 eV (similar to that of  $p^+$  poly-Si)." In an article entitled Field Emission Characteristics of  $\text{CoSi}_2/\text{TaN}$ -Coated Silicon Emitter Taps, Han et al. state that "the work functions of  $\text{CoSi}_2/\text{TaN}$  calculate to be about 4.00 and 4.39 eV, respectively." Finally, in an article entitled Optimum Electrode Material for  $\text{Ta}_2\text{O}_5$  Capacitors for High- and Low-Temperature Processes, Matsuhashi et al. indicates in Table II that the work function of TaN after annealing is 4.55 eV. Therefore, based upon the teachings of these three new references (in addition to the prior references of Gotoh and Rogers) that tantalum nitride can have a work function below 4.95 eV, the Examiner cannot argue that tantalum nitride of Choi inherently has a work function greater than 4.95 eV. Since the Examiner cannot rely upon the doctrine of inherency to disclose this feature, which the Examiner admits is not specifically

disclosed by Choi, Applicants submits that Choi fails to identically disclose the claimed invention within the meaning of 35 U.S.C. § 102. Thus, Applicants respectfully solicit withdrawal of the imposed rejection of claims 1-2, 7-12 and 15 under 35 U.S.C. § 102 for anticipation based upon Choi.

**Claim 13 is rejected under 35 U.S.C. § 103 for obviousness based upon Choi in view of Kook et al., U.S. Patent No. 6,008,123 (hereinafter Kook)**

On page six of the Office Action, the Examiner asserted that one having ordinary skill in the art would have been motivated to modify the semiconductor device of Choi in view of Kook so as to arrive at the claimed invention. This rejection is respectfully traversed.

Claim 13 depends ultimately from independent claim 1, and Applicants incorporate herein the arguments previously advanced in traversing the imposed rejection of claim 1 under 35 U.S.C. § 102 for lack of novelty as evidenced by Choi. Specifically, Choi neither discloses nor suggests that tantalum nitride has a work function greater than 4.95 eV. The secondary reference to Kook does not cure the argued deficiencies of Choi. Accordingly, the proposed combination of references would not yield the claimed invention. Applicants, therefore, respectfully submit that the imposed rejection of claim 13 under 35 U.S.C. § 103 for obviousness based upon Choi in view of Kook is not viable and, hence, solicit withdrawal thereof.

Applicants have made every effort to present claims which distinguish over the prior art, and it is believed that all claims are in condition for allowance. However, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic interview would expedite the

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prosecution of the application to an allowance. Accordingly, and in view of the foregoing remarks, Applicants hereby respectfully request reconsideration and prompt allowance of the pending claims.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417, and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY



Scott D. Paul  
Registration No. 42,984

600 13<sup>th</sup> Street, N.W.  
Washington, DC 20005-3096  
(202) 756-8000 SDP/GZR:kap  
**Date: September 22, 2003**  
Facsimile: (202) 756-8087  
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Attachment: Appendix A